# PLANTERS' BULLETIN

## OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

NEW SERIES NUMBER FIVE

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RUBBER RESEARCH INSTITUTE OF MALAYA
INCORPORATED 1925

March
1953

# R R I

LOCATION The Institute's Laboratories and Offices are at the third mile, Ampang Road, Kuala Lumpur.

CORRESPONDENCE All *letters* must be addressed to the Director, Rubber Research Institute of Malaya, Post Office Box 150, Kuala Lumpur. Special inquiries may be marked for the attention of a particular officer, if so desired (See Staff List in Bulletin No. 1, page 24). The address for *telegrams* is Searching, Kuala Lumpur. *Telephone:* Kuala Lumpur 3351/2/3. *Parcels* occasionally arrive without any indication of their origin. It is requested that senders will write their names and addresses clearly on the outside of all packages, and also advise the Institute by letter or telegram of their despatch. This is especially important for perishables, such as latex samples and plant specimens.

PROHIBITED PLANT SPECIMENS Attention of planters and others in territories outside the Federation of Malaya and the Colony of Singapore is drawn to the Malayan Plant Importation Rules which prohibit the importation into Malaya of any part of a plant, whether living or dead, unless it is accompanied by a permit issued by the Director of Agriculture, Federation of Malaya. No permit will be issued in respect of any diseased plant or any plant pest. Any plant imported in contravention of these Rules (whose object is to prevent the introduction of diseases or pests) will be destroyed without examination. Anyone outside Malaya who desires our advice on pests or diseases or any other matters that may require examination of living material must first submit an inquiry by letter giving the fullest possible description of their problem.

ADVICE Inquiries are invited from rubber producers in the Federation of Malaya, the Colonies of Singapore and North Borneo, and the territories of Sarawak, Brunei and Nigeria, who may require more detailed information applicable to their own special problems. *Interviews* should be arranged by letter or telephone, as members of the senior research and advisory staff are frequently absent on visits to plantations. The Institute is open from 8 AM to 1 PM and 2 PM to 4 PM on Mondays to Fridays, and from 8 AM to 12.30 PM on Saturdays.

EXPERIMENT STATION AND FACTORY This station of the R R I is situated 16 miles from Kuala Lumpur, at Sungei Buloh on the Kuala Lumpur — Kepong — Kuala Selangor road. Visits may be made on Mondays or Wednesdays by arrangement with the Director of the Rubber Research Institute (see *Correspondence* above). There is a guest house

# PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur March 1953 New Series No. 5

## Editorial: Research Must Expand

### WHY RESEARCH ?

The development of the rubber industry in a century of progress has of necessity been based on empiricism through lack of any deep seated knowledge of the nature of rubber or of the scientific aspects of rubber manufacture. Although much progress has been made and more can be achieved by inspired empiricism there is no doubt that it is in the application of new scientific knowledge that the greatest hope of further progress lies.

One has only to look back to the state of our knowledge fifteen years ago to realise how little was then known of the nature of rubber. True, the famous German chemists Weber and Harries had discovered many years before that rubber was essentially a compound of carbon and hydrogen atoms, containing a large number of identical small units each containing five carbon and eight hydrogen atoms, and that there was present what the chemists call a 'double bond'. Yet only fifteen years ago opinions differed widely as to whether rubber consisted of clusters of quite short chains of these units, or of individual long chains of which the fundamental units formed the links. Even in the oldest and most important major process used in the rubber industry, namely vulcanisation, it was not known whether chemical action of sulphur on rubber was essential to accomplish vulcanisation or whether the latter had a purely physical explanation, while the ideas then prevailing as to the nature of oxidation as manifest in such important processes as milling, ageing and perishing were scanty and often quite erroneous.

### ACHIEVEMENTS OF FUNDAMENTAL RESEARCH

How very different is the state of affairs today. We now know that rubber consists of very long chains containing at least five to ten thousand of individual links or units, arranged in regular sequence like lines of pins placed head to tail, each chain being able to slide past its neighbour. We know why rubber is plastic and why it can be moulded and shaped into the various forms of commerce. We have found out a good deal about vulcanisation, how through the agency of sulphur the long chains become firmly tied together as in a net and so are no longer free to slide one past the other and the new rubber has tensile strength, freedom from plastic flow and freedom from tack, to mention only a few of the attributes of vulcanised rubber. We know that ageing and perishing are due to the action of oxygen as also is the softening which occurs during milling, and we know quite a lot about what happens when oxygen attacks rubber. Since attack by oxygen results in extensive breakdown of the rubber chains into quite small pieces, it is clear how important it is to prevent or minimise such oxidation by avoiding undue

exposure of the raw material to air and especially to sunlight, and by the addition, during manufacture, of substances which either prevent the attack of oxygen or stop the attack before any real damage is done. With the knowledge now gained of the fundamental nature of vulcanisation and oxidation, the way is open for a systematic application of this knowledge to effecting improvements in rubber by new or improved vulcanisation technique, and by new and improved methods of preventing oxidation and its deleterious effects.

We know, too, why rubber is elastic, and with this knowledge has come the realisation that our material is not unique, a fact of which we have become only too well aware with the advent of synthetic rubbers, not one of which has the same composition or structure as our natural product !

The presence of the double bond, referred to above, enables us to vulcanise rubber, but it is also a disadvantage in that, in conjunction with the particular arrangement of atoms in its immediate vicinity, it provides a point in the rubber chain which is very easily attacked by oxygen. On the other hand the double bond and the reactivity of its neighbouring atoms enables us to treat rubber chemically and so prepare from it a number of useful materials, thus increasing the consumption of rubber by extending its field of application.

## RUBBER RESEARCH IN GREAT BRITAIN

Research on rubber in the United Kingdom is undertaken by the Research Association of British Rubber Manufacturers (R.A.B.R.M.) the British Rubber Producers' Research Association (B.R.P.R.A.) and its associated development unit Rubber Technical Developments Ltd (R.T.D.), the London Advisory Committee for Rubber Research, Ceylon and Malaya (L.A.C.), and by several industrial research laboratories.

The R.A.B.R.M. under the directorship of Dr J.R. Scott is essentially a manufacturers' research association supported by the majority of the manufacturers of rubber goods in Great Britain. Their problems are mainly those of the rubber consuming industry although considerable fundamental research is undertaken in the study of some of the manufactures' particular difficulties.

The work of the L.A.C. is of course closely linked with that of the Rubber Research Institutes in Ceylon and Malaya, and much of its work is directly connected with problems of the producing industry here in the East.

The B.R.P.R.A., directed by Dr G. Gee, has made important contributions to our fundamental knowledge of rubber, since its inauguration in 1937, but even before that date some members of its present staff were working on rubber derivatives under the auspices of the Rubber Growers' Association, in close cooperation with Dr P. Schidrowitz and Dr H.P. Stevens.

Most of the aforementioned research achievments on the elucidation of the mechanism of oxidation and vulcanisation have come from the laboratories of the B.R.P.R.A. The practical significance of these and similar fundamental researches is not always immediately apparent. The policy of B.R.P.R.A. in pursuing these researches and disseminating their results by scientific publication is beginning to yield a harvest

which is none the less real because it is not always easy to pinpoint. Today's industrial developments reflect a growing understanding of rubber; an understanding to which B.R.P.R.A. has made many valuable contributions.

Practical developments which are more directly traceable to B.R.P.R.A. and R.T.D. researches are now beginning to emerge and the next few years can reasonably be expected to be fruitful in this respect. Among projects on the verge of commercial realization may be mentioned the production of cyclised rubber for shoe soles, of vapour permeable waterproofings for clothing, and of 'Positised' woollen garments showing enhanced wear. Looking a little further ahead, a range of chemically modified rubbers is under examination having properties ranging from rubbers, through leathers, to ebonites and plastics: these have potential application in many fields, some of which are not at present open to ordinary rubber. Among rubber applications already established may be mentioned various uses in paints and fluid compositions; these stem from older researches formerly sponsored by the R.G.A. and brought to fruition by B.R.P.R.A. and R.T.D.

## INTERNATIONAL COOPERATION

Shortly after the war in Europe ended contact was re-established between the B.R.P.R.A. and its sister organisations, the Rubber-Stichting in Holland and the Institut Francais du Caoutchouc in France. Annual meetings are held in the three countries in turn and at these meetings there is much interchange of ideas—always a valuable stimulus for research. The lines of work pursued by the three groups are complementary; *e.g.* while all are interested in polymer modified rubbers, their approaches differ in details. The Rubber-Stichting pioneered the chemical treatment of rubber in latex form and has developed commercial production of rubber hydrochloride by this method. The French group has given most attention to the reinforcement of latex films by means of resins, and has been able to make experimental tyre treads by this process.

Contact with America is maintained informally by exchange of visits; many prominent American research workers have visited the Welwyn Garden City laboratories, while members of the B.R.P.R.A. regularly visit the American rubber industry and research laboratories, and attend some of the big rubber conferences. Relations with the American workers are most cordial, and through these personal contacts the B.R.P.R.A. has been fortunate in having had first-hand knowledge of progress in synthetic rubbers.

## AMERICAN RESEARCH METHODS

One thing has always emerged forcibly from these American contacts, that is the immensity and drive of the American research effort. It is only too apparent that for every pound available for research in England, something like ten times as much are spent in America. Where one worker is manfully struggling with a research problem in England, his counterpart in America has a whole team of specialists at his command. It is generally agreed that when a new process is successfully accomplished in a laboratory, at least five years are usually required

before large scale production is possible. It is unfortunately true that the translation of research results into production is more rapid and efficient in America than in England; the establishment of R.T.D. represents an attempt to speed up the process so far as natural rubber research is concerned.

### WHAT OF THE FUTURE ?

The competitive threat of the American synthetic rubbers is a powerful spur to more intensive research on the natural product, especially in the East where the raw material is most amenable to investigation and treatment. It has long been known that rubber leaving the tree is accompanied by a number of other substances, in quite small amounts, yet only within the last few years has been realised the significance of these substances in influencing the properties of rubber itself—for good or for ill. Although much is known of the fundamental nature of rubber in sheet form as investigated in England, little is known of the nature of rubber as it leaves the tree, or as it is present within the tree itself. Even latex when investigated in England appears to have undergone some change during transit and storage, and although the industry has been handling latex for years only comparatively recently has it been found to be readily separable into yellow and white fractions (not to be confused with yellow and white fractions obtainable by fractional coagulation), the former containing a considerable proportion of the non-rubber substances.

The lack of knowledge of the fundamental nature of our raw material in the past has perhaps been due to some extent to difficulties in obtaining equipment suitable for conducting fundamental research in the East, but with the intensification of the more fundamental research effort of the R.R.I., in close cooperation with the B.R.P.R.A., these arrears are being overhauled.

It may be confidently argued that these fundamental researches will lead to the more effective use of natural rubber; together with the development of chemical modifications of natural rubber they provide a sound basis for confidence in the future of Malayan rubber.

---

*Important:*

## T. C. R.

The International Rubber Research Board has agreed that in view of the doubtful value of the Mooney viscosity measurement to consumers, the technical classification of natural rubber will be based only on the vulcanisation characteristic with effect from 1 January 1953.

Thus the shape of the symbol will no longer have any significance and a 'Circle' of the appropriate colour will be marked on all bales of technically classified rubber. The classes will therefore be *'Red Circle'*, *'Yellow Circle'* and *'Blue Circle'* corresponding to low, medium and high modulus rubbers respectively.

It is hoped that the number of technical classes will facilitate the marketing of the rubber by restricting the range of types of classified rubber available to the consumer.

# Hand Pollination in Hevea Brasiliensis

HAND POLLINATION IS ONE OF THE METHODS employed by the plant breeder for improving a crop. In rubber, hand pollination has been used for many years in Indonesia, Indochina and Malaya. The technique of hand pollination in Hevea is simple but requires practice and skill, and any intelligent labourer can carry it out after some training.

The rubber tree flowers twice a year, from February to June and from August to October, the first flowering season being considered the best one. During the seasons, masses of flowers appear at the end of the small leafy branches where the new season's growth appears after wintering. A bunch of these flowers is called an inflorescence, each inflorescence being branched and flowers appearing on all the branches. The inflorescences bear both the male and female flowers, the latter being situated at the end of the central axis of the inflorescence and at the ends of each of the side branches. The male flowers occur in much greater numbers on all the lesser shoots and branches of the inflorescence. The flowers of both the sexes are surrounded by a bell shaped corolla usually of five yellowish petals.

The female flowers can be distinguished by their terminal position on the inflorescence and by their bigger size, and by a small green button-like expansion at the base of the petals. When the petals of the female flowers are opened, a round green ovary can be seen inside, with three white lobes called stigmas at the top. The ovary with the stigmas forms the reproductive part of the female flower.

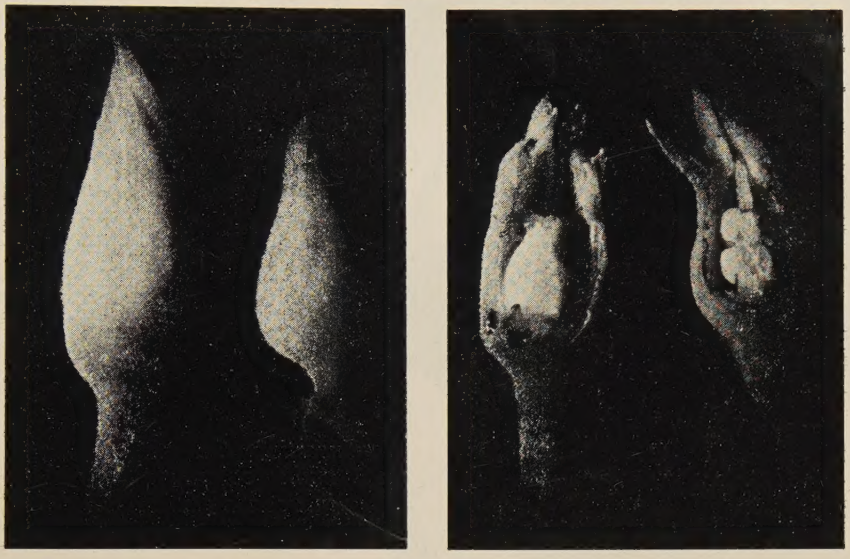
The male flowers are more yellow in colour and smaller in size than the female flower. When the petals of a male flower are opened a white central column is found surrounded by two rings of tiny yellow rounded projections, these latter being the anthers. When the anthers are ripe, they split and disperse a yellow powder which is the pollen.

The following equipment is used to carry out hand pollinations: (*1*) a pair of forceps, (*2*) a small pair of scissors, (*3*) a wide mouthed bottle of methylated spirit and (*4*) labels and twine. The forceps, scissors and hands are sterilised in the methylated spirit before starting work.

Pollen should be collected from the one tree which is to be the male parent, and when more than one tree of a clone is used as the male parent there should be no mixing of pollen. The mature unopened male flowers are collected from the inflorescences of the tree, but all opened and immature male flowers are rejected. Collection can be made with a pair of scissors into a paper bag or test tube or into a bamboo tube, with a wet piece of cotton wool at the bottom of the receptacle so that the male flowers do not dry up. Alternatively the whole inflorescence can be collected and kept in a bamboo tube with a little water at the bottom of the tube and thus the inflorescence can be kept fresh for longer. Pollen can be picked out as and when required for pollination.

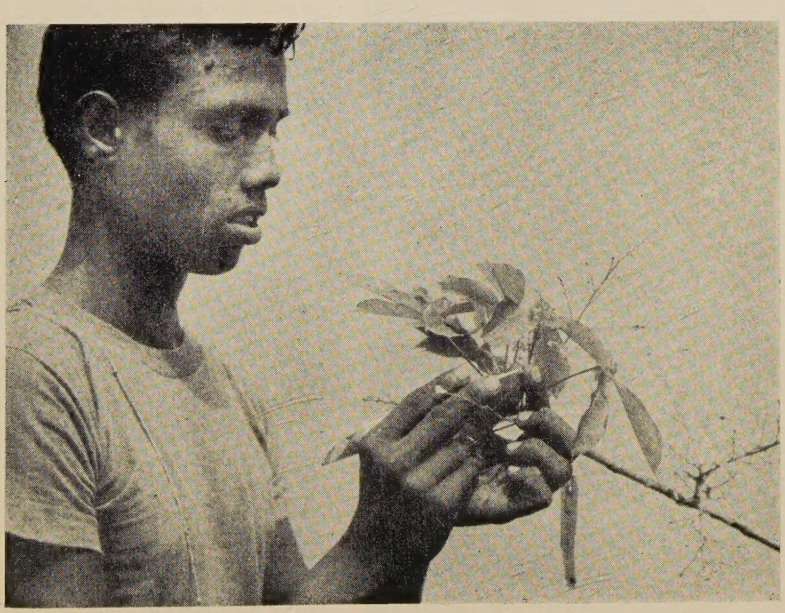
*Flowering branch showing large terminal female flowers and smaller male flowers.*

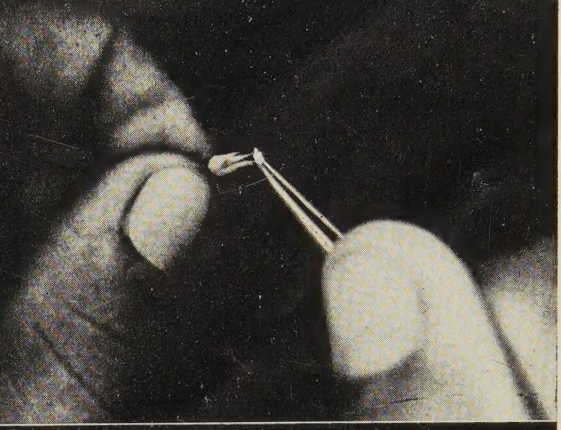
After collecting the pollen the operators next fertilise the female flowers. To facilitate work on the tops of trees a scaffoldings is sometimes erected so that the operators can reach the inflorescence. If there is no scaffolding, a ladder with a small platform at the top can be used. If boys are used as operators they can climb the trees and pollinate without any scaffolding or ladder. It is usual to select mother trees which are young and which bear many branches and flowers. The branches with the inflorescences are tied near the fork of the tree where the operators can sit conveniently and select an inflorescence which contains more than three or four flowers which will open on the same day. They remove from the inflorescence all the male flowers and all the female flowers except those which they are going to pollinate. The petals of the female flowers are then opened gently with the sterilised forceps (a gentle tap at the tip of the flower helps to open it) to expose the ovary



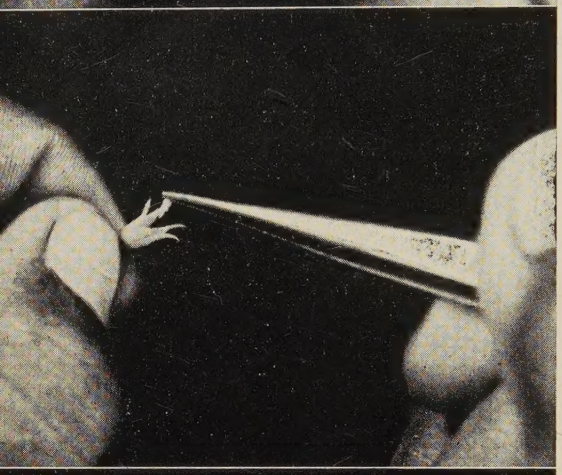
*Comparison of larger female flower with smaller male flower. On the right the flowers are sectioned to show stigmas and ovary in the female, and staminal column in the male.*

and stigma. The operator takes a male flower and carefully removes the petals, then plucking out the whole of the staminal column with the tip of the forceps. The column is now inserted into the female flower with the anthers next to the stigma and a small plug of cotton wool is placed

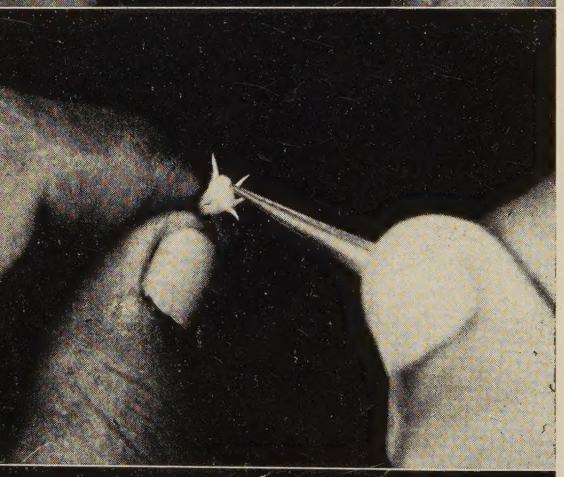




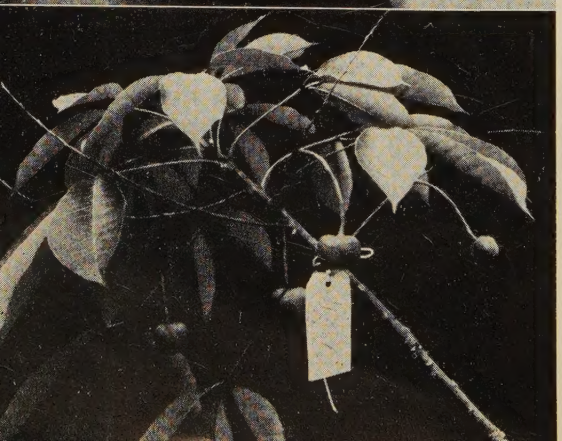
*Removing the anthers from a male flower by taking out the staminal column complete.*



*Inserting the anthers and staminal column into a freshly opened female flower.*



*Inserting cotton wool to prevent entry of further pollen.*



*Young fruit, the result of hand pollination, with label.*

above the staminal column closing the mouth of the corolla of the female flower. A drop of latex can be put between the petals and the plug so that it will not be blown away by the wind. This plug also keeps the staminal column in position and prevents foreign pollen getting into the flower. When all the female flowers in the prepared inflorescence have been pollinated, a label is tied to the inflorescence.

Correct labelling is of the greatest importance. The operators are supplied with a set of labels numbered serially, each label consisting of a tag label with a paper label attached to it. The tag label and the paper label have the same number written on them and the operator marks the paper label for each flower he pollinates on the inflorescence. He retains the paper label after tying the tag label to the inflorescence and at the end of the day the paper labels are collected to show the number of pollinations made for each pollination number. When operators are literate, they are supplied with a small note book and pencil and they note the number of pollinations performed for each pollination number. Labels are tied with a double knot enclosing the stalk of the inflorescence in one knot and the branch in the other because it proves difficult to distinguish hand pollinated fruits from naturally pollinated fruits, as both types may grow on the same branch.

Records of pollinations done are kept on the following form:

*1* Date of pollination
*2* Pollination number
*3* Field and tree number (on which the pollination was carried out)
*4* Name of pollinator
*5* Number of flowers pollinated
*6* Cross
*7* Final harvest (Number of fruits, seeds *etc*)

Two or three days after pollination the cotton plug and the dried petals of the female flower fall off. If the pollination has been successful the ovary will begin to grow into a fruit, if not the inflorescence will dry and fall off. At first the growth of the fruit is slow, but after one or two months growth becomes more rapid. The fruits are ready for harvesting between the fourth and fifth months. When the fruit is fully matured, and just before it begins to show signs of drying, it is enclosed in a net bag. This is necessary because if the fruit dries and splits naturally the seeds would be lost. When the netted fruits dehisce the seeds remain inside the net bag. The fruits are harvested as soon as they turn brown and the seeds are planted immediately in baskets for germination in the nursery.

Success in hand pollination depends on various factors. Most important are the temperature and rainfall immediately after the pollination and during the growth of the fruit. Another factor is the skill of the operator, in that one may be better than the others and may get a better percentage of successes. There is also a difference in the fertility of different crosses, for instance Clone Tj. 1 crosses better with P.B. 86 than Lun. N, and in the direction the crosses are made, for instance more fruits are obtained in a cross between Tj. 1 and B. 84 when Tj. 1 is used as the female parent than when B. 84 is used as the female parent.

*Bagged fruit, newly mature, with label.*

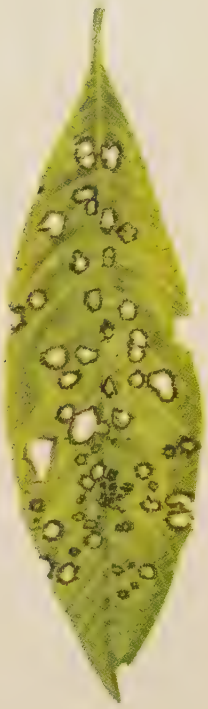
*Fruit showing dehiscence.*

An average success of 5% of fruit is considered fair. It was claimed in pre-war Java that a man doing this work on a commercial basis was able to get up to 15% success by crossing Clone Tj. 1 and Tj 16, the work being carried out by Javanese.

BOTANICAL DIVISION

# SOUTH AMERICAN LEAF BLIGHT OF RUBBER

*Primary stage*



*Secondary stage*

SOUTH AMERICAN LEAF BLIGHT is a very destructive disease of rubber. It is at present confined to Central and South America, but in these days of rapid air travel the chance of its spreading beyond the American continent has greatly increased. Should this disease be introduced into Malaya (despite the special precautions that are being taken to exclude it) any hope there is of eradicating it will have vanished unless appropriate action can be taken before it has had time to become widespread. The purpose of this leaflet, therefore, is to make you familiar with the appearance of this disease so that should it happen to find its way on to your rubber you will be in the position to recognise it and to report its presence immediately.

## SIGNIFICANCE

Judging by the amount of damage it has caused in Tropical America in the past, the seriousness of South American Leaf Blight can hardly be exaggerated. For this is the disease that was responsible for the collapse of the plantation rubber industry launched in the Guianas in the first decade of this century and, some years later, for the failure of the earlier attempts of the Ford and Goodyear companies to cultivate rubber in South and Central America. And since it so happened that two of these ill fated enterprises (those in the Guianas and Central America) were started with planting material imported from the Far East, we have indisputable evidence that the rubber grown in this part of the world is susceptible to the disease.

## APPEARANCE

South American Leaf Blight is caused by a fungus, *Dothidella ulei*. There are two stages to the disease. The form they take is illustrated on the front of this leaflet, and described below.

**Primary Stage**—At this stage, which occurs principally on the very young pendent leaves, the disease may be recognised by the presence (usually on the lower surface of the leaf) of dull, velvety looking spots, olive to greyish green in colour. If the infection is heavy, the young leaf soon blackens, shrivels up, and falls ; but when only a few spots develop the leaf continues to grow, and ultimately assumes a ragged shothole appearance.

Provided the olive green velvety spots are to be seen, it should not be difficult to distinguish South American Leaf Blight, even at this early stage, from the leaf diseases of rubber which already occur in Malaya, but shrivelling and blackening of a very young leaf is a symptom common to many of them. The characteristic symptoms of the three principal local diseases are illustrated on the back of this leaflet.

**Secondary Stage**—At this stage, which is the one that develops on leaves that have managed to survive the primary infection, the disease assumes its most characteristic form, and takes on an appearance which is entirely unlike that of any disease now occurring in the Far East.

The stage is characterized by the development, around the margins of the old spots, of innumerable small spherical black bodies. These bodies, which usually occur on the upper surface of the leaf, start to appear before the leaf is quite full grown and continue to arise for some time afterwards. Collectively they present an aspect that is quite unmistakable, and since they are hard and project some way above the surface they even affect the feel of the leaf, rendering it distinctly rough to the touch.

## WHAT TO DO
## IF YOU THINK YOU HAVE FOUND THE DISEASE

Provide yourself with :—

(*a*) a tin about six inches deep with a press-on lid,

(*b*) six or seven thicknesses of newspaper cut into a strip about five inches wide,

(*c*) a ten per cent solution of formalin.

Collect several leaves showing the suspected symptoms.

Thoroughly moisten the newspaper strip with the formalin solution, and then roll the leaves up in it carefully.

Place the roll in the tin, sprinkle it liberally with formalin, pour off any excess liquid, and then press the lid on tightly.

Parcel the tin, and despatch it to us at the address below, marked ' Suspected S.A.L.B.'

**In view of the serious nature of South American Leaf Blight, in no circumstances should suspect material be sent to us unless it has been disinfected and packed in the manner described above.**

Whenever possible the disinfection and packing should be carried out on the site of the suspected infection, so as to avoid spreading the disease.

Until you hear from us, stop all work in the area of suspected infection and do what you can to prevent anyone entering it.

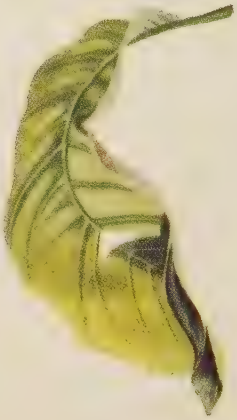
Pathological Division
Rubber Research Institute of Malaya
Kuala Lumpur

March, 1953

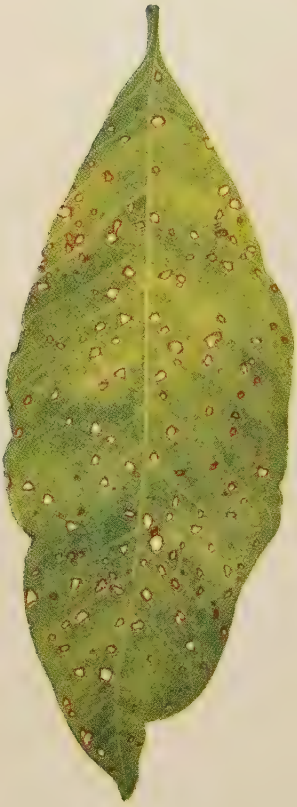
## *Compare*

### THREE COMMON LEAF DISEASES

MILDEW
*Oidium heveae*



The main cause of secondary leaf fall



BIRD'S EYE SPOT
*Helminthosporium heveae*

GLOEOSPORIUM LEAF SPOT
*Gloeosporium alborubrum*

Printed for the Rubber Research Institute of Malaya, by McCorquodale & Co., Ltd., London, England.

# A New Legume Bush Cover Plant Flemingia Congesta

*(F. macrophylla)*

THIS BUSHY LEGUMINOUS PLANT was first brought to the notice of the R.R.I. by Che Mohd. Aris bin Ahmed Patail who collected it in Kelantan. The plant is however to be found in inhabited localities over much of Malaya, and especially in the north. The Malay names are serengan, seringan jantan, beringan and ringan.

The plant grows into a dense compact bush branching from ground level. It may attain a height of up to ten feet. It stands slashing well. Owing to its deep rooting habit it seems to be a desirable plant to have where leguminous bush covers are wanted.

It sets an abundant quantity of seed in contrast to other leguminous cover plants, the supply of whose seed is nearly all imported. There is however a fly (Agromyza sp.) which lays its eggs in the green seed pods and the larvae eat the young seeds. For seed production, spraying of an insect deterrent is necessary. The seeds are slightly smaller than those of Pueraria species and weigh about 2000 to an ounce. In new clearings or replantings it may be planted by rows three feet apart with spacing of two feet in the rows. Three or four seeds should be planted per point.

As with many other legumes. Flemingia seed will give better germination results with acid treatment. The seedlings respond to inoculation and benefit from phosphate manuring, especially in the early stages of growth.

Flemingia grows vigorously in the open and it will compete with lalang but does not appear able to suppress it. On the R.R.I. Experiment Station it combats indigenous creepers such as Mikania and Passiflora.

*Slashed bush cover with three year old rubber.*

FLEMINGIA
CONGESTA

*Unslashed.*

*Habit of growth of young plants under light shade.*

*Slashed bush cover with three year old rubber.*

A well established cover of Flemingia will survive for a time under maturing rubber when the canopy has become dense, though its growth becomes straggly.

Small quantities of seed will be issued to estates against the cost of collection and despatch.

BOTANICAL DIVISION

# Prang Besar 86 as a Seed Parent

CLONE P.B. 86 IS CONSIDERED TO BE AN EXCELLENT CLONE, and is recommended for large scale planting. As a consequence of this, interest has been shown in its progeny because of their availability and also because the clone has been used in a number of seed gardens.

Observations on the R.R.I. Experiment Station, also confirmed elsewhere, indicate that P.B. 86 produces flowers and sets fruit as early in its life as two years after budding. In later life it flowers profusely and produces masses of pollen. The main flowering season varies with climatic conditions, but usually commences in February. From then on the clone produces flowers, and sets seed until late April or May, and a case is on record of flowering continuing until August. The secondary flowering season is also prolonged, and continues from August until November. Clone P.B. 86 thus differs from others commonly used as parents, in that it flowers almost continuously. It has also been noted that it is a prolific seed parent.

These two facts taken together, indicate that P.B. 86 may set seed almost continuously throughout the year, and indeed flowers and fruit in all stages of development may be observed at the same time on one tree.

TABLE I: THE PERCENTAGE OF P.B. 86 MOTHER SEED IN SAMPLE COLLECTIONS FROM AN ISOLATED SEED GARDEN CONTAINING ELEVEN CLONES

| *Seed type* | *Sample Number and Date of Receipt* | | | | | |
|---|---|---|---|---|---|---|
| | (4) 17 *Sept* | (5) 24 *Sept* | (6) 30 *Sept* | (7) 13 *Oct* | (8) 19 *Oct* | (9) 24 *Oct* |
| *P.B. 86 mother seed* | 24.5 | 48.0 | 33.5 | 37.5 | 32.0 | 18.0 |
| *All other types* | 75.5 | 52.0 | 66.5 | 62.5 | 68.0 | 82.0 |

TABLE I is an extract from a table of analysis of seed collections from an Isolated Seed Garden on various dates. It is apparent that the seed crop from this garden contains a high proportion of P.B. 86 seed over most of the main seeding season.

In a programme of hand pollinations at our Experiment Station, clone P.B. 86 showed higher than average fertility in a serious of crosses, as shown by TABLE II. It is obvious that the 2.3% difference of the P.B. 86 crosses above all other crosses is large, when considering the small percentage success figures obtained. There is no doubt that clone P.B. 86 is above average in fertility, and that it seeds regularly and continually.

The yields of these crosses can be compared with the yields of all other crosses made during the same hand pollination programme. Other characters such as the occurrence of brown bast, and the girth of the seedlings can also be compared, and are given in TABLES III, IV and V respectively. Examination of these tables shows that in the three combinations in which it was crossed, clone P.B. 86 produces progeny which are lower yielders than the average of the progeny of all the

TABLE II: FERTILITY OF P.B. 86 CROSSES IN HAND POLLINATIONS

| *Cross* | *No. of pollinations made* | *No. of fruits harvested* | *Success percent* |
|---|---|---|---|
| *P.B. 86 × Pil. B.84* | 212 | 16 | 7.5 |
| *Pil. B.84 × P.B. 86* | 18 | 3 | 16.7 |
| *AV. 157 × P.B. 86* | 105 | 8 | 7.6 |
| *P.B. 86 × AV. 157* | 237 | 21 | 8.9 |
| *P.B. 86 × Tj. 1* | 134 | 8 | 6.1 |
| *Tj. 1 × P.B. 86* | 224 | 26 | 12.0 |
| *Total P.B. 86 crosses* | 930 | 82 | 8.8 |
| *Total of all crosses made* | 5294 | 346 | 6.5 |

other crosses. The P.B. 86 progeny have generally a higher percentage of brown bast than the mean percentage of all the other crosses, and in addition they show a marked lack of vigour.

When considering these results from our Experiment Station, it must be clearly understood that they are from a small number of trees only. This does not, however, prevent us from generalising concerning the progeny of P.B. 86, and we assume in the absence of other concrete evidence that since P.B. 86 does not produce good families of seedlings when crossed with Tj. 1 and AV 157, which we consider to be two of

TABLE VI: TRIAL OF CLONAL SEEDLINGS LISTED IN TABLE I

| *Sample No.* | *Acres* | *Year 1* | | *Year 2* | | *Year 3* | | *Year 4* | | *Mean 4 yrs* | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *lb per ac.* | *% control* | *lb per ac.* | *% control* | *lb per ac.* | *% control* | *lb per ac.* | *% control* | *lb per ac.* | *% control* |
| 4 | 2.5 | 932 | 290 | 884 | 122 | 1013 | 108 | 1092 | 110 | 980 | 132 |
| 5 | 2.5 | 1077 | 335 | 973 | 134 | 1005 | 107 | 1060 | 107 | 1029 | 138 |
| 6 | 2.5 | 1024 | 319 | 971 | 134 | 1020 | 109 | 1115 | 113 | 1032 | 139 |
| 7 | 2.5 | 886 | 276 | 888 | 122 | 972 | 104 | 1032 | 104 | 944 | 127 |
| 8 | 2.5 | 1114 | 347 | 963 | 132 | 991 | 106 | 1041 | 105 | 1027 | 138 |
| 9 | 2.5 | 982 | 306 | 952 | 131 | 960 | 102 | 1081 | 109 | 994 | 133 |
| *Mean* | | 1002 | 312 | 938 | 129 | 993 | 106 | 1070 | 108 | 1001 | 134 |

*Tapped S/2.d/2.100%* *Control clone is Pil. B.84*

TABLE III: YIELD OF P.B. 86 SEEDLINGS IN LB/TREE/ANNUM, 1946-51
*Tapped S/2.d/2.100%*

| *Parents* | *Tj. 1* Mean 1946-51 | *AV 157* Mean 1946-51 | *Pil.B. 84* Mean 1946-51 | *General mean* 1946-51 |
|---|---|---|---|---|
| *P.B. 86* | 10.7 | 13.6 | 10.6 | 11.6 |
| *Eleven other clones* | 14.3 | 14.0 | 13.5 | 13.9 |

TABLE IV: BROWN BAST INCIDENCE OF P.B. 86 SEEDLINGS 1946-51

| *Parents* | *Tj. 1* | | | *AV 157* | | | *Pil.B. 84* | | | *Total* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Mature trees* | *Cases in period* | | *Mature trees* | *Cases in period* | | *Mature trees* | *Cases in period* | | *Mature trees* | *Cases in period* | |
| | | *Trees* | % | | *Trees* | % | | *Trees* | % | | *Trees* | % |
| *P.B. 86* | 62 | 17 | 27 | 55 | 13 | 24 | 29 | 12 | 41 | 146 | 42 | 29 |
| *Eleven other clones* | 235 | 64 | 27 | 151 | 29 | 19 | 132 | 45 | 34 | 518 | 138 | 26 |

TABLE V: GIRTH MEASUREMENTS IN INCHES AT 50 INCHES FROM THE GROUND

| *Parents* | *Tj. 1* | *AV 157* | *P.B. 84* | *Mean* |
|---|---|---|---|---|
| *P.B. 86* | 25.0 | 28.7 | 23.3 | 25.7 |
| *Eleven other clones* | 27.9 | 30.5 | 28.7 | 29.0 |

the best parents in the far east, it would probably not produce good families with other clones as parents.

Our opinion in this matter is supported by some results from our experimental planting on estates. The seeds from each sample number shown in TABLE I were planted out on one estate and the results obtained are shown in TABLE VI.

On the other hand seed from an Isolated Seed Garden containing only 2.4% of P.B. 86 mother seed was planted out on a number of estates with the results shown in TABLE VII.

TABLE VII: TRIALS OF ISOLATION GARDEN SEED CONTAINING 2.4% OF P.B. 86 MOTHER SEED

| *Estate* | *Acres* | *Year 1* | | *Year 2* | | *Year 3* | | *Year 4* | | *Mean4yrs* | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *lb per ac.* | *% control* | *lb per ac.* | *% control* | *lb per ac.* | *% control* | *lb per ac.* | *% control* | *lb per ac.* | *% control* |
| *A* | 2.5 | 731 | 189 | 794 | 185 | 778 | 148 | 763 | 144 | 771 | 166 |
| *B* | 2.0 | 922 | 129 | 926 | 116 | 1069 | 136 | 1226 | 146 | 1036 | 132 |
| *C* | 3.5 | 1771 | 203 | 1953 | 170 | 2084 | 181 | 1305 | 114 | 1778 | 167 |
| *D* | 1.6 | — | 209 | — | 182 | — | 137 | — | 112 | — | 160 |
| *E* | 2.1 | 1218 | 344 | 1218 | 313 | 1304 | 246 | — | — | — | — |
| *F* | 3.7 | — | 132 | 864 | 125 | 860 | 126 | — | — | — | — |
| *Mean* | | 1160 | 201 | 1151 | 182 | 1210 | 162 | 1064 | 129 | 1195 | 156 |

*Tapped S/2.d/2.100%* *Control clone is Pilmoor B.84*

When comparing these figures, the best yardstick to use is the entry 'percentage of control', the control being clone Pil. B. 84 throughout. There is no doubt that using this criterion, the seedlings with the lower percentage of P.B. 86 mother type seed TABLE VII give a better performance than those in TABLE VI.

From the evidence set out so far we consider that a large proportion of clone P.B. 86 in a seed collecting area detracts from the value of the seed. Owing to the fertility of clone P.B. 86, seed collected from areas in which the clone is represented is likely to contain such a high percentage. We recommend that in any seed mixture not more than 15 to 20% of mother seed of clone P.B. 86 should be accepted for commercial planting.

There is another disturbing characteristic of clone P.B. 86. The late Dr R.J. Chittenden reported that several Prang Besar clones give a proportion of yellow leaved seedlings in their progeny, and that this proportion may be in the order of 15% in selfed seed. Certain other

clones were reported to give only green leaved progeny even when crossed with a type giving yellow leaved progeny. Dr Chittenden also reported the occurrence of these yellow leaved seedlings in three types. One type has green leaves in shade, but on exposure to the sun the leaves turn yellow. The second type commences with yellow leaves which later turn green. The seedlings of the third type are yellow throughout their lives. He did not recommend yellow leaved seedlings for planting, but thought that they would be suitable for budding.

The yellow colour of the seedlings is due to the absence of the green pigments known as chlorophylls, and in our experience the occurrence of yellow foliage is frequently associated with a lack of vigour. This fact is borne out by crosses made at our Experiment Station of clones P.B. 86 x Pil. B. 84 and P.B. 24 x Pil. B. 84. (No yellow leaved seedlings appeared in any other cross with clone Pil. B. 84 nor did they occur in other crosses with P.B. 86 and P.B. 24.) The yields and girths of the yellow leaved seedlings in these crosses are given in TABLE VIII; the seedlings being of the second type described by Dr Chittenden.

TABLE VIII: YIELDS OF TREES WITH GREEN AND YELLOW FOLIAGE

| | *Family* | *Foliage* | *Total planted 1939* | *Died before 1947* | *Tapped 1947* | *Girth @ 50 ins 1948* | *Yield in gm per tree per tapping 1947* |
|---|---|---|---|---|---|---|---|
| *1* | *P.B.* 86 x | *green* | 33 | 8 | 20 | 23.2 | 40.8 |
| | *Pil.B.* 84 | *yellow* | 16 | 7 | 5 | 16.4 | 19.2 |
| *2* | *P.B.* 24 x | *green* | 29 | 11 | 16 | 24.0 | 41.2 |
| | *Pil.B.* 84 | *yellow* | 12 | 4 | 5 | 20.0 | 55.6 |

In family *1* the mortality of the yellow leaved seedlings is greater, and in both families the yield and girth of the yellow leaved seedlings are inferior to those of the green leaved seedlings.

If mother seed of P.B. 86 appears in seed used for planting, it seems to us that a proportion of this seed, quoted by Dr Chittenden as 15%, may be unsuitable for planting, in addition to the 'runts' which might also occur. This is another cogent argument for examining samples of seed containing P.B. 86 progeny, to ensure that there is only the quoted percentage (15 to 20%) in the bulk of the seed. The number of yellows occurring may be serious economically, when the proportion of P.B. 86 progeny is high.

*Summary*

*1* Clone P.B. 86 is extremely fertile.

*2* The progeny are below average in respect of yield and vigour.

*3* In certain crosses with P.B. 86 as a parent a proportion of yellow leaved seedlings appear which develop into inferior trees.

*4* We recommend that no seed be accepted for planting which has over 15 to 20% P.B. 86 progeny in it.

BOTANICAL DIVISION

# Inoculation of Cover Crop Seed

THE ROOTS OF MOST LEGUMES bear nodules containing bacteria which have the power of fixing the gaseous nitrogen in the soil. Nitrogen is taken up by the plant only when in the combined form; thus the presence of the bacteria closely associated with the roots adds to the supply available. This is particularly important where the plants are growing on poor soils.

Root nodule bacteria are species of *Rhizobium*, of which there many strains; with any one legume some are more effective than others, some are totally ineffective. Being widely distributed in the soil they will sometimes induce nodulation of cover crop plants without special measures being taken; but, to ensure nodulation with a good strain, seed should be inoculated before planting.

*Cultures* — The Pathological Division maintains cultures of root nodule bacteria of proved effectiveness on a range of leguminous cover plants, ready for subculturing and distribution when required. The bacteria are grown on a sterilised agar medium in tubes plugged with cotton wool which should not be removed until the cultures are about to be used. For safe transit the tubes are packed in wooden boxes. *Rhizobia* can be supplied for each of the three most extensively planted covers, *Centrosema pubescens, Pueraria phaseoloides* (*Pueraria javanica*) and *Calapogonium mucunoides,* as well as for certain others.

Best results are obtained with cultures that are fresh; they should any way be used within a week after receipt. Arrangements can be made for a succession of consignments if planting is to extend over a period longer than this.

*Procedure* — To inoculate the seed a bacterial suspension is made. Ordinary water is satisfactory for the purpose, but in our laboratory experiments with *Centrosema pubsecens* better results were obtained when the bacteria were suspended in formic acid serum. One pint—sufficient to treat about 20 lb of seed—can be made up from one culture tube as follows:

> Remove the cotton wool plug and pour in the suspension medium (serum or water) until the tube is three parts full. With a clean glass rod or thin wooden skewer, rub the bacterial culture off the surface of the nutrient agar and mix it with the liquid. No harm is done if some of the agar comes away in the process, but it is better avoided. Stir the concentrated bacterial suspension into the bulk of the suspension medium, rinsing the tube once or twice into the main stock.

Place the 20 lb of seed in a clean bucket or other suitable container and pour the suspension over it, stirring well to ensure that all the seed is thoroughly wetted. It should then be spread out in a thin layer to dry, and planted out as soon afterwards as possible.

*Supplies* — *Rhizobium* cultures have in the past been supplied to estates free of charge. Of late the quantities required have increased so much that it has been decided to institute a small charge (50 cents a tube) to cover labour and expendible materials, the tubes and boxes in which they are packed being returnable. In the event of their non-return

an additional 50 cents a tube will be charged to cover cost. Cultures will be supplied in mutiples of five tubes. When ordering supplies the following information should be given:

*i* the species of cover crop to be inoculated,
*ii* whether seed of different species is to be mixed,
*iii* the number of tubes required (one tube for each 20 lb of seed),
*iv* when the cultures will be needed.

A week should be allowed for the necessary cultures to be prepared.

*This article supercedes the advisory leaflet P/AL 6(50) of the Pathological Division. A limited number of reprints are available on request—Editor*

PATHOLOGICAL DIVISION

## South American Leaf Blight

South American leaf blight has recently been observed on rubber plantings of 25 years and 9 years in the Republic of Honduras. This does not represent a spectacular advance of the disease as it has been established for some years in Costa Rica and Mexico, and more recently in Guatemala; but it means that the disease has now completed its distribution throughout all areas in Central America where rubber is grown commercially. Its spread over Central America from its source in the Amazon basin is believed to have been accomplished by spore laden winds.

## Rubber Roads in U.S.A.

Rubber roads were pioneered in the United States by the Natural Rubber Bureau in 1949. Today, there are rubber roads in 17 states and several provinces of Canada. Massachusetts alone has over 350 miles of rubber road. New York City, Baltimore, Los Angeles, Washington, D.C. and Atlanta are among the cities having stretches of rubber road.

Mr Harry K. Fisher, Consulting Engineer in charge of the Bureau's rubber road programme notes 'We have had more requests from highway engineers interested in putting down rubber roads than at any previous period. It certainly looks as though 1953 is going to be the biggest year to date for rubber road.'

Rubber roads may well turn out to be a major contribution to the betterment of the American highway system. At the same time, they will provide a vast market for the use of rubber.

## Correspondence

The Editor of *Planters' Bulletin* invites letters of general interest for publication in this column. Comment and queries arising from articles recently published will be welcome. The name and address of the writer must be given in full, but may be withheld from publication if desirable.

## R. R. I. Lectures for Planters

During 1953 it will be possible for the following lectures to be given by senior officers of the R.R.I. Divisions:

SOILS

C.G. AKHURST: *Weed control*
G. OWEN (after October): *Soils and the nutrition of the rubber tree*

BOTANY

E.D.C. BAPTIST: *Problems of current interest on estates*
H.M. BURKILL: *Clones and clonal seedlings*
C.W. BROOKSON (until July): *Plant breeding and testing*
P. DE JONGE: *Yield stimulation*

PATHOLOGY

A. NEWSAM: *Termites and borers*
F.W. HUTCHISON (after June): *Spraying from the air*
R.N. HILTON (after September): *Windborne diseases*

CHEMISTRY

G.W. DRAKE: *Modified rubbers*
L.L. BEST: *Technically classified rubbers*
R.S. GALE: *Recent developments in factory techniques*
H.M. EDMONDSON: *R.R.I. method of bleaching crepe*

Inquiry may be made of the Director by interested organisations.

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